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The Role of Trees Outside Forests in the Cultural Landscape of the Colline del Prosecco UNESCO Site

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Abstract: The multifunctional role of Trees Outside Forests (TOF) is largely recognized in scientific literature, but they are still rarely considered in forest inventories and planning, with consequent underestimation of their role and amount. In addition, their cultural role has rarely been considered both at scientific and management level as well as in UNESCO sites. TOF characterize many European cultural landscapes, including the one of the Colline del Prosecco, inscribed in 2019 in the UNESCO World Heritage List. One of the reasons of the inclusion, in fact, is the landscape mosaic made of vineyards interspersed with small woodlands and tree rows. This paper focuses on two types of TOF, Small Woods and Linear Tree Formations (TOF NON A/U). Their detailed mapping and the performing of different spatial analysis allowed us to assess their role and to provide data for future monitoring and for local forest planning. Results confirmed that TOF NON A/U are one of the main features of the UNESCO site landscape: despite the limited overall surface (1.95% of the area), 931 different patches have been identified. Spatial analysis highlighted the key landscape and ecological roles, acting as intermediate features between large forest patches, and also an important role for hydrological protection (they can be found also in slopes above 80% of inclination). The study provided a detailed mapping and database of one of the main features of the Colline del Prosecco UNESCO site cultural landscape, verifying the multifunctional role of TOF NON A/U and the necessity to include them into local forest planning, but also suggesting their inclusion in national forest inventories.

Keywords: trees outside forest; forest management; forest planning; cultural landscape; cultural forests; UNESCO; Colline del Prosecco

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1. Introduction

The Prosecco hills is a cultural landscape included in the UNESCO World Heritage List (WHL) in 2019. The area is characterized by many trees, small woods and linear tree formations that are very typical of cultural landscapes characterizing the southern part of the European Continent [1]. The multifunctional role of Trees Outside Forests (TOF) is largely recognized in scientific literature since the 1990s, especially in developing countries [2], where they still have a key role in providing firewood, fruits, fodder and other products to rural communities [3–6]. Besides the productive and economic role, TOF provide multiple environmental services, especially in protecting soil and water resources, providing wildlife habitat, preserving biodiversity, acting as a component of the ecological network and characterizing landscapes [7–11]. In addition, their importance is growing in the last few decades, considering a global context affected by the spread of urbanized areas and infrastructures [12] and by the growth of agricultural monocultures [13].

Despite their recognition, there is a lack of studies concerning the role of forests and trees outside forests in the UNESCO cultural landscapes included in the WHL. These

forest formations belong to the category of cultural forests [14] and refer to the third pillar of sustainable forest management (social and cultural values) defined by the Ministerial Conference on the Protection of Forest in Europe in 2003 [15,16]. These tree formations are also a good sample of the biocultural diversity [17] that is typical of the European rural landscape.

The Food and Agricultural Organization (FAO) introduced TOF into their Global Forest Resource Assessment in 2000, but without providing a precise definition, describing them as trees growing outside the FAO definition of forest and other wooded land [9]. In 2005, the FAO added the category of Other Land with Tree Cover to its Global Forest Resource Assessment, defining it as "land classified as other land, spanning more than 0.5 hectares with a canopy cover of more than 10 percent of trees able to reach a height of 5 m at maturity" [18]. This definition unfortunately did not include all the lands with forest cover smaller than 0.5 hectares, which in reality often have a very important role from a landscape, ecological, or biodiversity point of view. More recently [19], the FAO clarified the TOF definition, dividing them into:

- TOF-AGRI: all lands predominantly under an agricultural use with trees and/or shrubs, whatever their spatial pattern (in line, in stands, scattered), provided that the area is $\geq$0.05 ha, the canopy cover is $\geq$5% if trees are present or $\geq$10% if combined trees, bushes and shrubs, the width $\geq$ 3 m and the length $\geq$ 25 m.
- TOF-URB: all lands predominantly under an urban use with trees and/or shrubs, whatever their spatial pattern (in line, in stands, scattered), provided that the area is $\geq$0.05 ha, the canopy cover is $\geq$5% if trees are present or $\geq$10% if combined trees, bushes and shrubs, the width $\geq$ 3 m and the length $\geq$ 25 m.
- TOF NON A/U: all lands not predominantly under agricultural or urban use, with:
  - i. Subset 1: small tree stands (0.05 $\leq$ area < 0.5 ha), with canopy cover $\geq$ 5% if trees are present or $\geq$10% if combined trees, bushes and shrubs.
  - ii. Subset 2: narrow linear tree formations, (3 m $\leq$ width < 20 m), with canopy cover $\geq$5% if trees are present or $\geq$10% if combined trees, bushes and shrubs.

Therefore, different types of TOF could be identified: sparse trees inside agricultural or urban areas, small areas with forest vegetation and linear tree formations.

Despite the shared recognition at the scientific level regarding the importance of TOF, the lack of their inclusion in forest assessments or in national forest inventories led to little knowledge and data of TOF across large areas and therefore to the underestimation of their role and amount [19–21]. Part of this lack is due to technical difficulties and in particular to the discrepancy of scales and resolution between the necessity to survey large areas and the required resolution for detecting and mapping TOF. Most of the national and global forest inventories and assessments are carried out through automatic detection of forest surfaces, and due to the reduced size of TOF, it is complex to properly detect them, especially dealing with low- or medium-resolution remotely sensed imagery at the global or national level. Only a few national forest inventories take into account TOF, as the Forest Survey of India that started to include TOF in its surveys already in 1991, recognizing their importance in contributing to the timber and fuelwood needs of the country and therefore to the wellbeing and necessities of rural communities [22]. Concerning Italy, TOF are not officially included in national forest inventories, but on the basis of some partial results of the inventory, parallel investigations have been produced, reporting that TOF cover 1.5% of the country surface, most of them (88%) located in agricultural or pastoral areas [23]. For study areas of a limited surface, instead, it is easier to obtain and manage high-resolution images and therefore to detect and map TOF [21,24], while only a few studies focused on TOF detection through low-resolution satellite images [25–27]. In the last few years, thanks to the progress in remote sensing technologies and to the increased availability of free high-resolution images, detection and mapping of TOF can be performed with higher precision on large surfaces (i.e., national or regional level), even if the use of automatic identification is still subject to a certain number of errors [28]. Studies dealing with the assessment of the historical presence of TOF are also important [29,30], but had

to rely on historical aerophotos with a good resolution; otherwise, it is not possible to detect TOF accurately [31]. The use of historical maps or of cadasters, instead, can be problematic due to compatibility. Different TOF-focused studies used different images (aerophotos, orthophotos, satellite images, LIDAR) and different methodologies, from photointerpretation to automatic classifications [21,22,26,32–35], but all of them agree regarding the necessity of including TOF in official forest statistics and inventories.

It is therefore clear that there is a growing necessity to assess the importance of TOF both at national and local level, for their multifunctional role. In addition, TOF should be included in forest management plans, as they can have an important role in providing firewood, timber or other nonwood forest products besides the ecosystem services.

One of the most important roles of TOF, particularly in European countries, is related to the landscape characterization, especially in internationally recognized cultural landscapes, such as the one of the Colline del Prosecco. According to the statement of Outstanding Universal Value (OUV), in fact, the site is characterized by a "mosaic landscape where the plots dedicated to vineyards [. . .] coexist with forest patches in an organic system, respectful to the soil and the topography. The patches of vineyards are often connected to one another by small woodlands, hedges, rows of trees that serve also as corridors connecting different habitats. [. . .] The result is a harmonious landscape with outstanding scenic values that maintains a delicate environmental and functional balance" [36]. Therefore, it is clear that TOF, and in particular small woods and linear tree formations, have a key role in characterizing the landscape of the UNESCO site, as testified also by the fact that the "landscape mosaic" is one of the three attributes of the site, together with the "geomorphology" and the "ingenuity of the farmers".

This research is part of a bigger project whose final aim is to contribute to the UNESCO site Management Plan and in particular to provide the Regional Government and the UNESCO site Management Body a detailed and updated land use map and database to set a baseline for future monitoring of land use changes. The research presented in this paper focuses on TOF NON A/U; therefore, we do not consider olive or fruit orchards or trees in urban areas, as they have a completely different role in local landscape. The main aim is to deepen the knowledge of this important resource in a context where its presence is crucial for preserving the attributes of the traditional landscape mosaic recognized by the UNESCO WHL inscription. In addition, the data provided by this study will actively contribute to the Forest Management Plan of the UNESCO site that is required by the Regional Government, with the inclusion of TOF NON A/U into the main forest planning instrument at the local level.

2. Materials and Methods

2.1. The Study Area

The study area corresponds the Core Area of the UNESCO site Le Colline del Prosecco di Conegliano e Valdobbiadene, located in the Veneto Region in northeastern Italy, for a total surface equal to 9191 hectares (Figure 1). Before the UNESCO recognition, in 2016, the area was included in the National Register of Historical Rural Landscapes, an institution created by the Ministry of Agriculture, Food and Forestry Policies [37]. The area is mainly known as the winegrowing landscape of the Prosecco wine production area and presents a peculiar landscape mosaic mainly made of vineyards, small woods and larger forest patches. Main tree species found in local forests are *Castanea sativa*, *Fraxinus ornus*, *Ostrya carpinifolia*, *Quercus pubescens*, *Quercus robur*, *Quercus petraea* and *Robinia pseudoacacia*. One of the main characteristics of the site is the peculiar morphology, made by a system of parallel cordons of hills (called hogbacks) that stretch from the east to the west. The underlying geological structure has divided these hills into a series of main cordons and a further series of parallel cordons, creating a wide variety of geological formations and a unique and highly heterogeneous landscape. The typical bedrock is made up of large banks of alternating layers of conglomerate rocks, interspersed with calcareous marl and highly variable, densely layered flysch rocks dating back to various stages of the Miocene,

unexpectedly emerging from the high plains before continuing in wavy elevations with substantially horizontal stratifications in the local hills [36]. Local farmers adapted to this particular morphology by developing vine cultivation on very steep slopes through the realization of small *ciglioni*—small earth embankments. In fact, the area is characterized by steep slopes, confirmed by the fact that the average slope is equal to 38% and the maximum equal to 322%. Regarding the altitude, the study area ranges from 106 to 611 m a.s.l., with the average altitude equal to 261 m a.s.l.

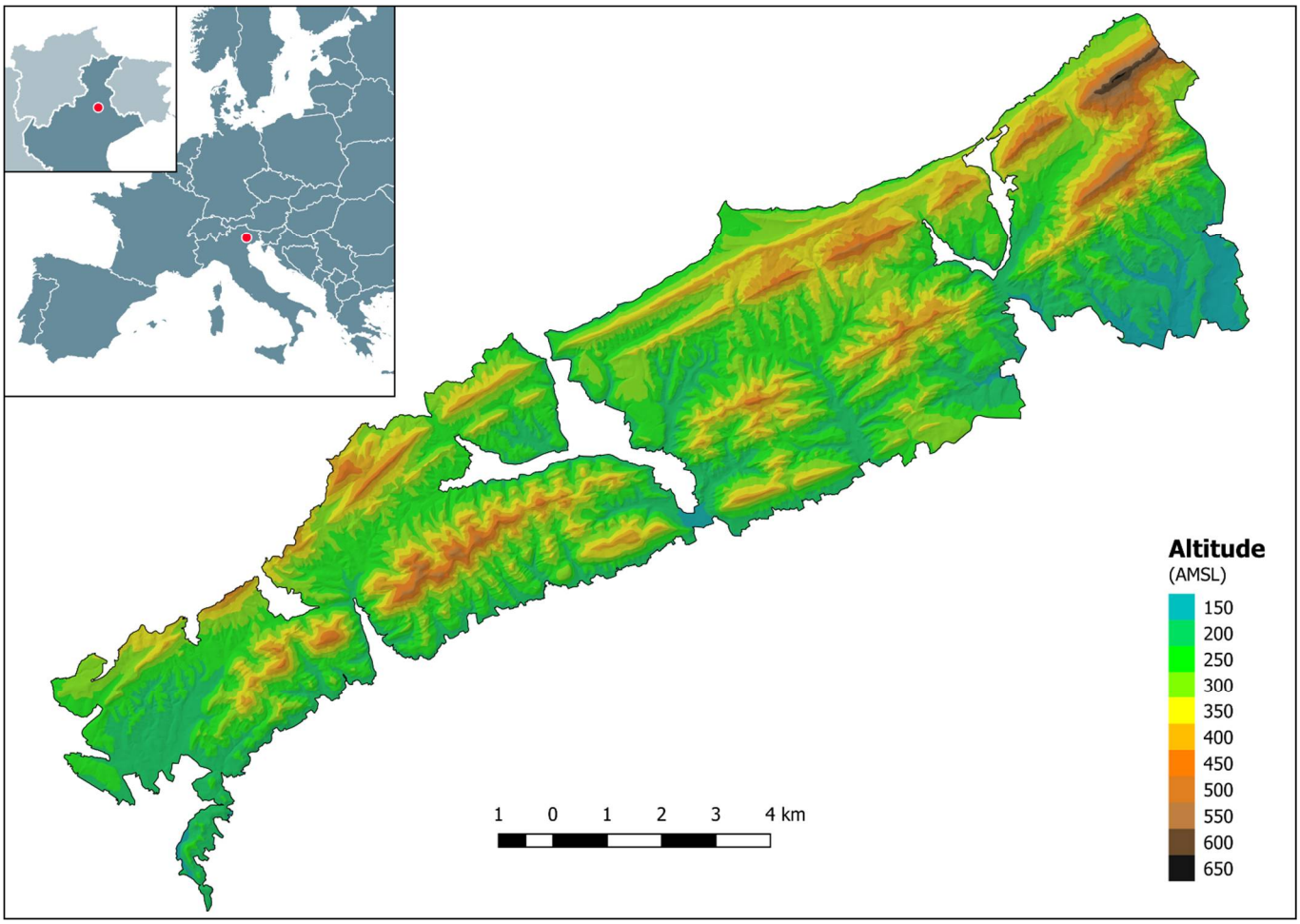


Figure 1. The study area, corresponding to the Core Area of the UNESCO site Le Colline del Prosecco di Conegliano e Valdobbiadene, is located in the Veneto Region in northeastern Italy.

The study area includes a Natura 2000 Network site, called Perdonanze e corso del Monticano (IT3240005), for a total surface of 364 hectares, almost entirely occupied by forests. According to the Köppen-Geiger climate classification [38], the area has a temperate oceanic climate (Cfb), with an average yearly temperature of 12.6 °C; the hottest month is July (average temperature of 22.5 °C), while the coldest one is January (average temperature of 2.4 °C). The yearly average precipitation is about 1099 mm.

2.2. The Land Use Mapping

The first phase of the study focused on the realization of an updated land use map of the Core Area of the UNESCO site. In fact, as the area is characterized by a high complexity of the landscape mosaic, it was necessary to carry out a detailed land use mapping, since other land use maps at national or regional level are not able to describe this complexity represented by the most characteristic features of the local landscape, such as the presence of small wooded areas and tree rows, the high fragmentation of the vineyards and the

many small and traditional rural buildings that dot the hills. The mapping was based on manual photointerpretation using the Quantum GIS (QGIS) software and high-resolution orthophotos (20 cm of resolution) of the year 2018 provided by the Web Map Service (WMS) of the Veneto Region. Since the aim of the land use mapping was to provide the Regional Government and the UNESCO site Management Body a detailed and updated land use map and database, various field surveys were carried out in the months of October, November and December 2021 to update the land use map to 2021. These field surveys were performed in places where the land use was not easily recognizable from the orthophotos or where the orthophotos highlighted "evolving" situations. In addition, a further check was carried out on the basis of 100 points randomly distributed within the Core Area of the UNESCO site through GQIS software, then checked in the field, not limiting the check to just the point but to all the polygons around. The legend adopted for the mapping is for the same reasons particularly detailed, especially for the agricultural part, for a total of 42 land uses, of which 13 refer to forests and minor forest formations. These data have not been included in the present study, as the focus of this part of the research is specifically on TOF NON A/U.

Regarding the delimitation of the areas classified as forests, it is necessary to briefly introduce the discrepancy between the FAO and the Italian definition of forest. The parameters used at national level in Italy are those indicated in the "Legislative Decree 34/2018—Consolidated law on forests and forestry chains", which states: "Forests are defined as the areas covered by arboreal forest vegetation, associated or less to shrubs, of natural or artificial origin at any stage of development and evolution, with an extension of no less than 2000 square meters, an average width of no less than 20 m and with forest tree cover greater than 20 percent". This definition of forest is different from the most widely used definition worldwide, which is the one adopted by the Food and Agriculture Organization (FAO), stating that forests are land with a tree canopy cover of more than 10%, an area of more than 5000 m^2 and a width of more than 20 m [39]. Despite the fact that the national definition of forest is different, in this research it was decided to apply the FAO definitions of forest and of TOF NON A/U to allow comparison of the results at the scientific and international level. Therefore, the areas with forest vegetation that did not reach these dimensional thresholds (5000 m^2, an average width of 20 m and tree cover greater than 20%) were not classified as forests but in two different classes, corresponding to TOF NON A/U:

- Small Woods: surfaces covered by forest vegetation with an area smaller than 5000 m^2, width greater than 20 m and canopy cover greater than 10%;
- Linear Tree Formations: surfaces covered by forest vegetation with a width between 3 and 20 m and canopy cover greater than 10%.

Olive or fruit orchards and single trees inside vineyards or inside other agricultural areas or urban areas and parks have not been considered in this study, as they have a different role, and the OUV statement of the UNESCO site only refers to small woods and to linear tree formations. In relation of other TOF typologies, it is important to highlight that in Italian traditional agriculture, mixed cultivation combining trees, vines and other crops existed since Etruscan times and represented the most extended agricultural typology until 1960 [40].

Spatial analysis was carried out with QGIS software, with the help of GRASS GIS plugin. Spatial analysis dealing with elevation, slopes and exposure of the slopes is based on the Digital Terrain Model (DTM) with a resolution of 5 m provided by the Veneto Region. From the DTM, slope and exposure maps were elaborated using the *r.slope.aspect* command from GRASS GIS plugin. The tool was set to consider inclination of 5% or lower as plain when calculating the exposure map. The first output was a raster of the inclination of the slopes of the area, expressed as a percentage; the second output was a raster map of the exposure, expressed in degree from north clockwise. Both maps share the same resolution of the DTM. The data were then reclassified, with the *r.reclass* command from GRASS GIS plugin, to obtain elevation classes, slope classes and exposure classes. The

DTM was aggregated in classes of 50 m, starting from 100–150 m a.s.l. up to 450–500 m a.s.l.; the slope in classes of 10% up to 80%, including the steeper slopes in a single class ">80%"; the exposure in 8 classes represented the main cardinal and ordinal directions: north, northeast, east and so on. To extract the statistics only for TOF NON A/U areas, the "zonal statistics" analysis from QGIS was used, set to extract the dominant (most frequent) attribute, for all the TOF NON A/U polygons extracted from the land use map. The result from these elaborations gives, for each patch of TOF NON A/U, the dominant elevation class, the dominant slope class and the dominant aspect class. To elaborate the map of distance from forest and TOF NON A/U, all these areas were extracted and rasterized and then elaborated with the Proximity (raster distance) QGIS tool. Once all the forest and TOF NON A/U patches were excluded from the last layer, we calculated the average and the maximum value and then reclassified in classes to obtain a better visualization on the map. The classes are the following: 0–10 m, 10–20 m, 20–50 m, 50–100 m, 100–200 m, 200–300 m and 300 m.

2.3. The Use of Landscape Indexes

Since one of the main aims of the research was to provide spatial data for future monitoring of the presence of TOF NON A/U inside the landscape of the Core Area of the UNESCO site, we decided to calculate some commonly used landscape indexes to set a baseline, plus some other metrics to better evaluate the role of TOF NON A/U (Table 1).

Table 1. Landscape metrics applied for the evaluation of the role of TOF NON A/U in the Colline del Prosecco UNESCO site.

Name	Symbol	Formula	Description	Reference
Number of patches	NP		Number of patches of a particular class.	[41]
Mean Patch Size	MPS	MPS = a_i/n_i a_i = area of the *i* land use class in hectares; n_i = number of the *i* land use patches.	Average area of a patch of a particular class.	[42]
Patch Density	PD	PD = $N_i/A \times 100$ N_i = total number of patches of the *i* class; A = total surface of the study area in hectares.	Number of patches of a particular class calculated on the total surface of the study area (standardized per 100 ha).	[43]
Patch Density in Agricultural areas	PDA	PDA = $N_i/AA \times 100$ N_i = total number of patches of the *i* class; AA = total surface of agricultural patches in hectares.	Number of patches of a particular class per calculated on the agricultural surface of the study area (standardized per 100 ha).	
Edge Density	ED	ED = p_i/a_i p_i = perimeter of the patch *i* in meters; a_i = area of the patch *i* in hectares.	This index indicates the degree of fragmentation through the segmentation of edge.	[43]
Landscape Shape Index	LSI	LSI = $p_i/(2 \times \sqrt{(\pi \times a_i)})$ p_i = perimeter of the patch *i* in meters; a_i = area of the patch *i* in hectares.	Derived from ED. LSI increases without limit as the patch becomes more disaggregated.	[43]
TOF-Agriculture Shared Border	TASB	TAB = $P_a/P \times 100$ P_a = sum of TOF NON A/U perimeter shared with agricultural areas in meters; *p* = Total perimeter of TOF NON A/U in meters.	Percentage of TOF perimeter which borders with agricultural patches.	

3. Results

Wooded surfaces (including TOF NON A/U and shrublands) cover 56.4% of the UNESCO site Core Area, while the rest of the surface is mainly dedicated to vineyards (30%) and to other agricultural crops (9%). The rest of the surface is covered by settlements and infrastructures (4.3%) and by unproductive areas (0.1%). Regarding the wooded surfaces, most of them correspond to broadleaved forests of deciduous oaks, black hornbeam, chestnut and ashes. Forests of *Robinia pseudoacacia*, reforestation of conifers and riparian forest formations can also be found on smaller surfaces.

TOF NON A/U are found on a total of 178.80 ha, corresponding to 1.95% of the entire Core Area. Despite the fact that their overall surface is limited, they play a key role in the local cultural landscape: 658 Linear Tree Formations and 273 different Small Woods were detected during the photointerpretation and the field surveys. Regarding the species composition, it can be considered similar to the one of the local forests. The MPSs of Linear Tree Formations and Small Woods are equal to 0.20 and 0.17 ha, respectively. PD for Linear Tree Formations and Small Woods is equal to 7.2 and 3.0, respectively, but it reaches values of 18.4 and 7.6 (PDA) if it is calculated on the total of the agricultural surfaces (TOF NON A/U cannot be found inside forests or urban areas) instead of calculating it on the total study area surface, highlighting the importance of each in the local landscape. ED and LSI results show that Small Woods are more round-shaped, as expected, than Linear Tree Formations. Another interesting data comes from the measurement of the shared border between TOF NON A/U and agricultural areas (TASB). This analysis clarifies how TOF NON A/U patches are particularly interspersed into the agricultural landscape, as 77% of the perimeter of TOF NON A/U patches is shared with the perimeter of agricultural areas (Table 2).

Table 2. Landscape ecology indexes calculated for TOF NON A/U for 2021. The third column refers to the percentage calculated respective to the total surface of the Core Area.

TOF NON A/U 2021	Surface (ha)	Surface (%)	NP	MPS	PD	PDA	ED	LSI	TASB
Linear Tree Formations	131.21	1.43%	658	0.20	7.2	18.4	2481.3	215.27	72%
Small Woods	47.59	0.52%	273	0.17	3.0	7.6	1549.9	143.18	78%
Total TOF NON A/U	178.80	1.95%	931	0.19	10.1	26.0	2208.2	194.13	77%

Spatial analysis provided data about the particular disposition of TOF NON A/U inside the UNESCO site Core Area. TOF NON A/U are evenly distributed within the UNESCO site Core Area (Figure 2), except for some parts, i.e., highest altitudes or slopes facing north or northeast, that are mainly occupied by big and continuous patches of forests as they correspond to the areas less suitable for vineyards. The fact that TOF NON A/U are evenly distributed is also confirmed by the analysis of the maximum and average distance of each point of the agricultural and urban surface from a TOF NON A/U or from a forest patch. The maximum distance is equal to 435 m, meaning that inside the study area there are no points more than 435 m away from a TOF NON A/U or from a forest, while the average distance is equal to 40.7 m. As it is possible to observe from the distance map (Figure 3), maximum distances are found mainly in the southeastern part of the Core Area, where the morphology is slightly different and mainly represented by gentle hills that have been more affected by agricultural intensification than the rest of the study site. A further elaboration about the distances was carried out, calculating the same values as if TOF NON A/U had all been converted into agricultural lands (Table 3), to show their ecological and landscape role despite the limited overall surface. Results show that in this case the maximum distance to forests would be equal to 586 m, but it would be the average distance to highlight a very significant increase, passing from 40.7 to 69 m.

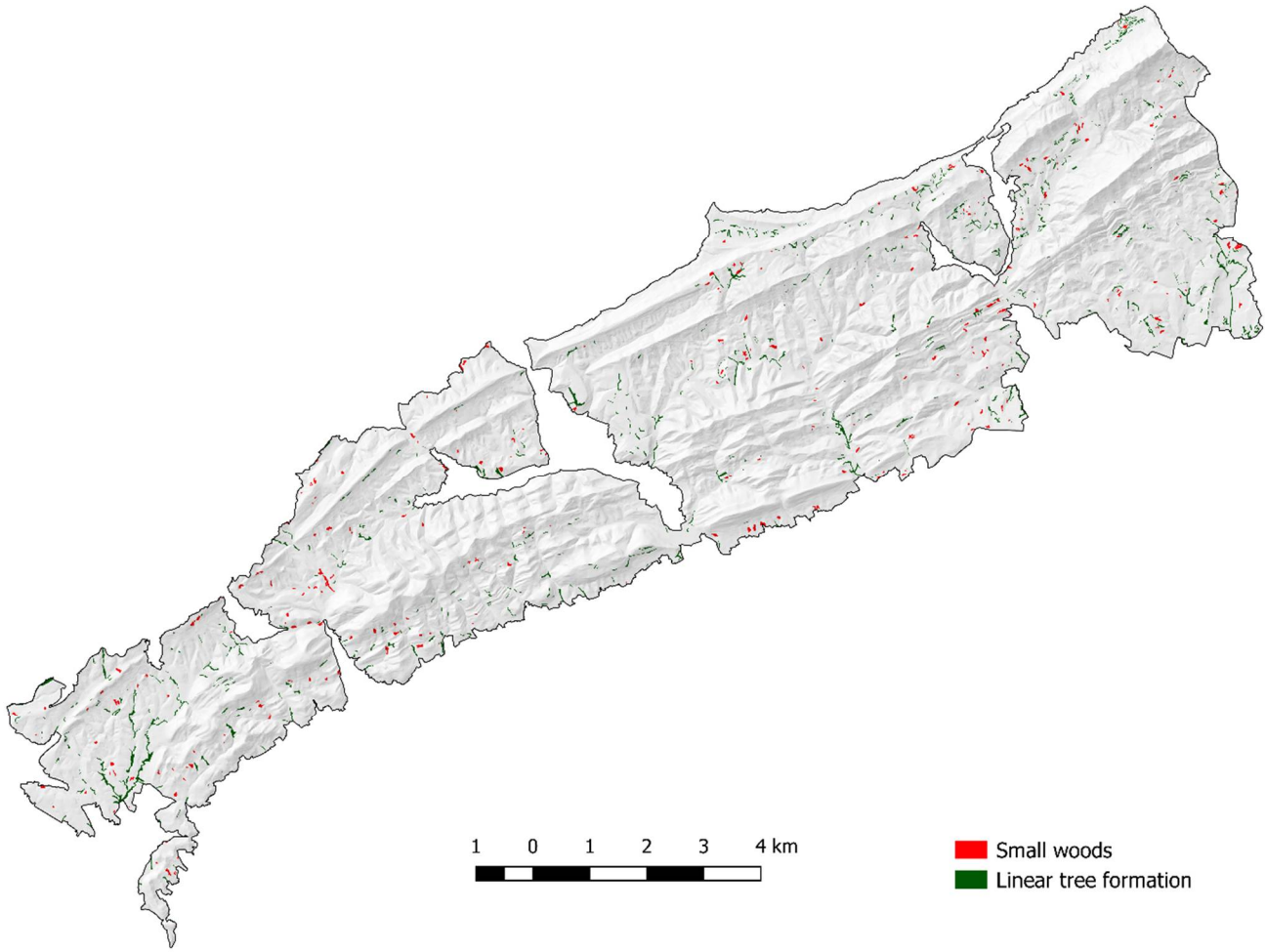


Figure 2. Map of the presence of Small Woods and Linear Tree Formations in 2021.

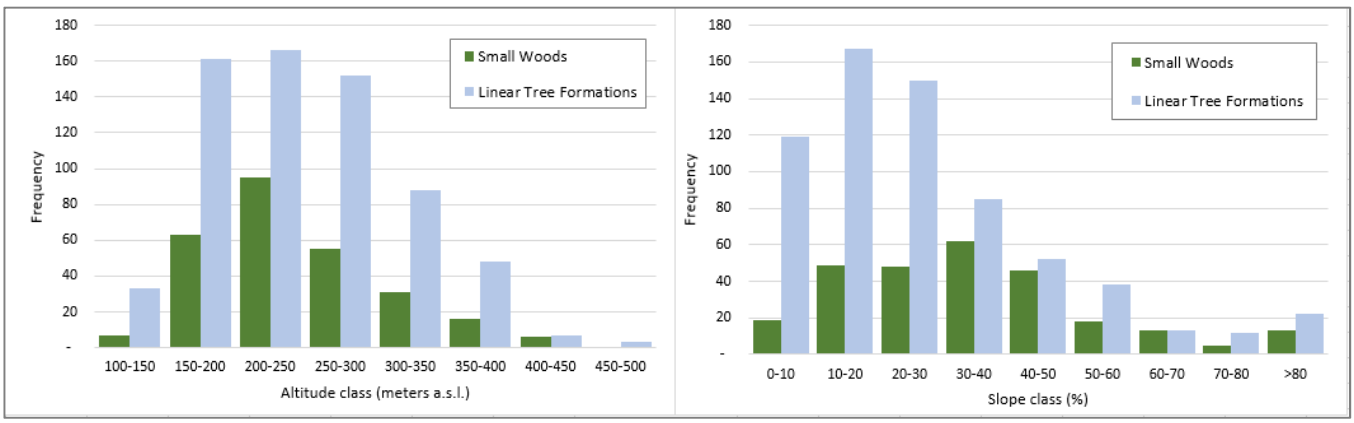
Table 3. Distance analysis of each point of the agricultural and urban surface from a TOF NON A/U or from a forest patch, considering and not considering TOF NON A/U. If all TOF NON A/U would be converted into agricultural areas, the distance would increase significantly, highlighting the important ecological role of TOF NON A/U for the connectivity of big forest patches.

Distance Class	With TOF NON A/U Included in the Analysis	Without TOF NON A/U Included in the Analysis
0–10 m	22%	16%
10–20 m	18%	13%
20–50 m	32%	26%
50–100 m	20%	21%
100–200 m	8%	15%
200–300 m	1%	5%
>300 m	0%	3%

Regarding the distribution of TOF NON A/U according to the altimetry and considering the subdivision of the total surface of the study area into the same altimetric classes (Figure 4a), the distribution of TOF NON A/U does not follow the same trend, but they are more concentrated in the areas between 150 and 250 m a.s.l. It is interesting to notice that there is a clear trend regarding the average surface of both TOF NON A/U types, as the average surface decrease as the altitude increase (Table 4). Concerning the distribution according to the slope class (Figure 4b), most TOF NON A/U are located in the slope classes between 10 and 40%. Linear Tree Formations are also common in the 0–10% slope

class. Another interesting point is the fact that TOF NON A/U, in particular Linear Tree Formations, can also be found in the most extreme slopes, above 80%. The analysis of the distribution of TOF NON A/U according to the exposure of the slopes, did not provide interesting or statistically relevant results, as it seems that TOF NON A/U do not follow any significant trend regarding the exposure.

Figure 3. Map of the distances of agricultural and urban areas from TOF NON A/U or from forests.



(**a**) (**b**)

Figure 4. Graphs of the distribution of the two typologies of TOF NON A/U according to altimetry (**a**) and to slope class (**b**) in the Colline del Prosecco UNESCO site Core Area in 2021.

Table 4. Variation of the average surface of TOF NON A/U according to the different altitudinal classes.

Altitudinal Class	Surface of the Study Area (ha)	Small Woods			Linear Tree Formations			Total TOF NON A/U		
		Surface (ha)	Number	Average Surface	Surface (ha)	Number	Average Surface	Surface (ha)	Number	Average Surface
100–150 m	273.63	1.65	7	0.24	12.71	33	0.39	14.36	40	0.36
150–200 m	1691.06	11.05	63	0.18	46.20	161	0.29	57.25	224	0.26
200–250 m	2585.04	17.63	95	0.19	30.64	166	0.18	48.27	261	0.18
250–300 m	2132.18	8.72	55	0.16	22.54	152	0.15	31.25	207	0.15
300–350 m	1367.47	5.54	31	0.18	12.68	88	0.14	18.21	119	0.15
350–400 m	764.79	2.18	16	0.14	5.76	48	0.12	7.94	64	0.12
400–450 m	264.76	0.83	6	0.14	0.51	7	0.07	1.33	13	0.10
450–500 m	73.40	-	-	-	0.19	3	0.06	0.19	3	0.06
>500 m	45.30	-	-	-	-	-	-	-	-	-
Total	9191.00	47.59	273	0.17	131.21	658	0.20	178.80	931	0.19

4. Discussion

Results of the research demonstrated that TOF NON A/U are one of the main features of the cultural landscape of the Colline del Prosecco UNESCO site, as stated in the OUV of the nomination proposal (Figure 5). In fact, 931 TOF NON A/U have been identified, corresponding to 178.8 hectares. Despite the fact that this surface represents only 1.95% of the total surface, PD, PDA, TASB, and the distance analysis confirm that TOF NON A/U are a crucial part of the landscape mosaic and that they have also an important ecological role. TOF NON A/U can effectively represent an ecological network, connecting or acting as intermediate features between large forest patches, as demonstrated through the distance analysis with and without TOF NON A/U. Results also highlighted that TOF NON A/U can also have a role in hydrological and landslides protection, as they can be found also in the most extreme slopes, since 35 of them are located in the slope class above 80%.

Figure 5. One of the main features of the cultural landscape of the UNESCO site Colline del Prosecco is represented by TOF NON A/U, which are found interspersed with vineyards, often cultivated on very steep slopes, or as a connection between large forest patches.

This multifunctional role of TOF is also confirmed by other studies in different parts of the world, highlighting the social, cultural, ecological, economic and protective functions, as well as carbon sequestration [19,28,44–46]. Other studies, in contrast, emphasized the role of TOF in pest dispersal and invasive species expansion [47]. In the Colline del Prosecco UNESCO site, the main function is probably related to cultural landscape conservation, as they are one of the main features characterizing the landscape mosaic structure, but it is important to highlight that they also have ecological and protective functions, as demonstrated by the results.

Our results are in line with a national survey reporting that TOF (including TOF-AGRI and URB) cover the 1.4% of the national surface. The same survey reports an increase in TOF in the period 1990–2013 of 17.1% in their number and of 27.4% in their overall surface, while the average surface remained unchanged [48]. According to Sallustio et al. [49], TOF represent essential elements of the green infrastructure network in many Italian landscapes, but the expansion of big and continuous forest patches on marginal lands and, on the other side, the agricultural intensification, can lead to a decrease in TOF and in the historical landscape mosaic structures. Similar findings have been reported for southern Spain and Italy by Hidalgo et al. [50], where residual "island forests" could act as "stepping stones" in the local ecological network. TOF are also important for landscape perception, especially in intensive agricultural landscapes, as they contribute to increase the landscape heterogeneity and to the visual interruption of large extensions of monocultures [51].

Due to their importance in the European landscape and to their multifunctionality, the assessment of TOF is of increasing importance, at the local, regional or national level. It is also important to apply a standard definition and classification of TOF, and the one given by the FAO seems to be the more appropriate. A detailed assessment of TOF, such as the one carried out in this research, is also important as it represents a baseline for future monitoring.

5. Conclusions

The applied methodology proved to be effective in providing a detailed mapping and database of one of the main features of the cultural landscape of the UNESCO site Colline del Prosecco. Since landscape transformations related to the viticultural sector are common in the site, it was important to carry out a detailed assessment of TOF NON A/U within the Core Area in order to monitor their changes in the near future. Moreover, cultural landscapes included in the UNESCO WHL often lack in scientific assessment and data regarding the landscape features that guaranteed the inclusion in the WHL. Accurate assessments can also serve to check the effectiveness of local and national territorial policies and planning and of the UNESCO recognition in protecting the landscape itself. Further data about TOF NON A/U in the Colline del Prosecco UNESCO site could be derived by the analysis of older orthophotos or aerophotos, but the main limitation relies in the fact that the aerophotos of the area dating back to the 1960s or to previous years have a poor quality, not allowing an accurate detection of TOF NON A/U within the site.

Despite the different definitions of forest at international (FAO) and national levels, it was decided to apply an international standard, as results could be easily compared to studies carried out in other countries and because the area is an UNESCO site.

Results of our survey allow us to make four main considerations about the importance and the role of TOF NON A/U in the Colline del Prosecco UNESCO site:

1. the study identified the cultural origin of TOF NON A/U in the area;
2. the study verified and assessed the key landscape role of TOF NON A/U as expressed in the UNESCO site OUV statement;
3. the vast majority of TOF NON A/U are located at "accessible" altitude and slope; therefore, they are traditionally linked to agriculture and cultivation practices, proving their important cultural role; in fact, in the past, most of them were pollarded or coppiced to obtain firewood, poles or wicker for vineyards, and the signs of these kinds of utilizations can still be observed in the area;

4. a minority part of TOF NON A/U, instead, are found at more "difficult" altitudes and slopes, where it is not possible to cultivate vines, so in the past they were probably left unutilized by local farmers for the hydrogeological protection of the lower vineyards.

Results of our study showed that TOF NON A/U can be considered as cultural indicators related to historical landscapes. In addition, results claim for the preservation of TOF NON A/U in the UNESCO site, especially with reference to the recent trend of planting new vineyards. The planting of new vineyards should be carefully evaluated, especially if it is planned on open areas (pastures, meadows) or in place of small woods, as this trend could seriously affect the preservation of the traditional landscape mosaic and of the associated biodiversity. TOF NON A/U, in particular, should be protected from land use changes, while new vineyards should be allowed to only replace shrublands or small forest patches resulting from the recent abandonment of agricultural surfaces. Finally, the study contributed to the deepening of the knowledge of TOF NON A/U in the Colline del Prosecco UNESCO site, setting the stage for further investigation but, above all, highlighting their multifunctional role and the necessity to include this resource in local forest planning with the purpose of protecting them from land use changes, and also suggesting the inclusion of TOF NON A/U in national forest inventories and statistics.

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